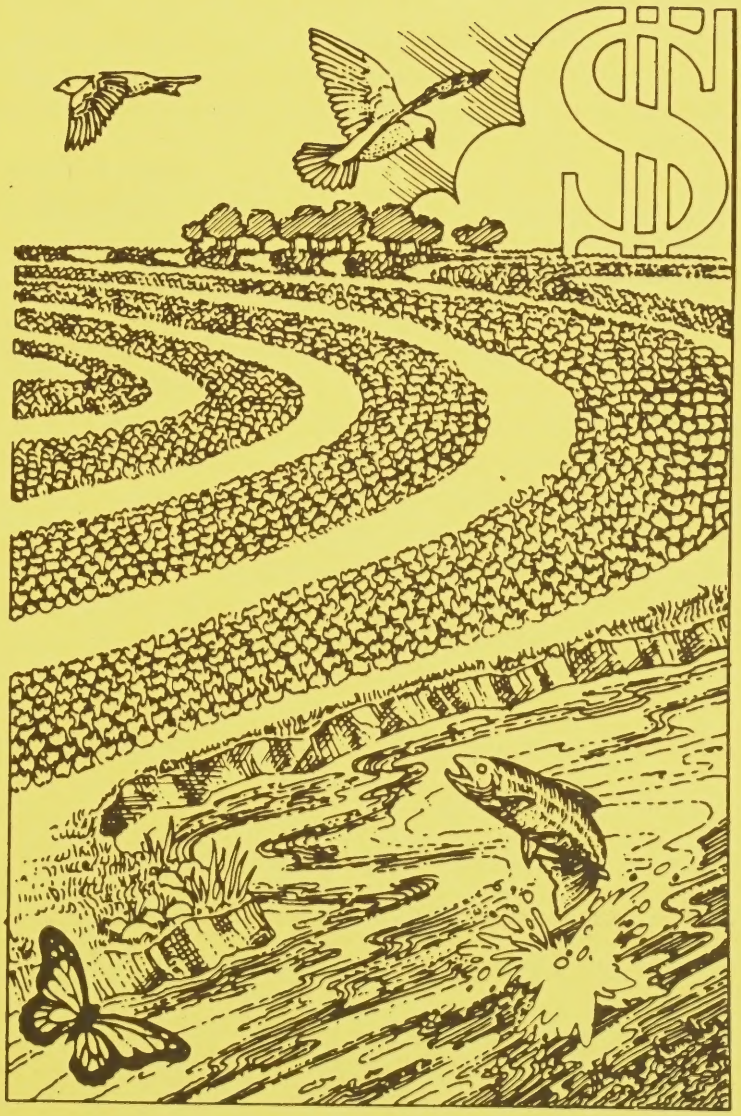
NORTH DAKOTA

North-Central Region Projects Supported by Sustainable Agriculture Research and Education Program



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from project reports

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Overview of North Dakota Projects

Congress has provided strong and growing support for the Sustainable Agriculture Research and Education grants program, also known as LISA (Low-Input Sustainable Agriculture). Administered by Cooperative State Research Service (CSRS), with the Cooperative Extension Service as a full partner, this program is forging partnerships between farmers, scientists, educators, agribusiness, non-profit organizations, and government -- a partnership that is beginning to promote better stewardship of the Nation's natural resource base. The program has supported 112 new projects since its inception in 1988; perhaps two dozen more will be funded by June.

Projects funded are typically carried out by teams of farmers, university research and education staff, government agencies, non-profit organizations, and private enterprise. Top priority is given to whole-farm integrated systems projects, usually including on-farm research and demonstrations. These projects are providing scientific documentation of low-input sustainable farming practices and systems, in comparison with conventional or chemical-intensive agriculture.

Farmer involvement is one of the strengths of this program. There has been active involvement in the administration of the North Central Region LISA program since its inception. Five producers from the region have served on the Administrative Council which develops policy and distributes funds. Six producers have also served on the Technical Committee which evaluates and recommends project proposals for funding.

Nationwide, 1,860 farmers have participated in projects during the first three years. When farmers participate in the planning and execution of a project, two important things happen. Concerns of farmers are foremost in the design of the project. And scientists get directly exposed to innovative ideas developed or tried by farmers. These ideas often become an integral part of scientific studies. The result is both better science and a more widespread adoption of more sustainable farming methods that are economically viable, socially acceptable, and environmentally sound, assuring cleaner water and a plentiful supply of safe food for generations to come.

The coordinators of North Dakota projects were asked about participating farmers. Here is what they reported:

- A total of 111 North Dakota farmers have participated in LISA research and education projects;

- 29 are reported to have helped generate ideas for these projects, and 14 help manage the projects;

- 10 farmers have provided land for replicated experiments; another 53 provided land for unreplicated studies, and one for demonstration plots;

- 20 are helping with the evaluation of projects; and

- One producer (Fred Kirschenmann) is serving a 4 year term on the Administrative Council.

Projects Funded 1988-1990

Five projects funded by this program that include North Dakota scientists, farmers, or educators in major roles are described here. These projects received a total of $842,450, and provided $740,511 matching funds. In most of the projects, a scientist serves as the Project Coordinator. In others, a farmer or other local area residents are contributing to a multi-state project headquartered in another state.

Substituting Legumes for Fallow in U.S. Great Plains Wheat Production (LNC88-10)

Summary

Wheat-fallow production systems have been used for nearly a century in the wheat producing Great Plains states of Kansas, Nebraska, North and South Dakota. In addition to moisture conservation, fallow is also practiced to mineralize nitrogen and control weeds. While stabilizing wheat yields on a bushel per-acre basis, fallow leaves a sizeable acreage idle each year and contributes to wind and water erosion. In other wheat producing areas of the world, such as Southern Australia, cereal grain/legume companion crop production systems are utilized to keep the soil covered, fix atmospheric nitrogen, reduce weed competition, and provide improved grazing potential. Recently, these systems have been explored in the U.S. Palouse and Northern Plains wheat production areas and have exhibited the potential to reduce agrichemical inputs, both conserve and improve the soil resource, and increase net return per acre.

The value of legumes in rotation and as companion crops is well documented in humid areas. Less is known and only limited success has been demonstrated in semi-arid condition with traditional species, such as sweetclover and alfalfa. Alternative species which use less water, such as black medic (*Medicago lupulina L.*), seem feasible in the spring wheat region of central North and South Dakota.

To further identify the potential of legumes replacing fallow in the wheat production areas of the U.S. Great Plains, a number of locations have been identified which represent a continuum of moisture stress, from the most humid (north and east) in North Dakota, to the most arid (south and west) in Kansas. In the most humid region, 10 farmers are cooperating to test alternative legumes (primarily black medic and sweet clover) and alternative legume management systems in large, replicated plots. These sites are serving as a research and demonstration source for utilization by an on-farm research coordinator from the Michael Fields Agricultural Institute, State Extension Services, and the Northern Plains Sustainable Agriculture Society. Small plot and feasibility research on black medic and other alternative legumes and production systems are being conducted on experiment stations by North Dakota State University at Carrington, University of Nebraska at North Platte, and by Kansas State University at Tribune. On-farm sites will require from two to four years to assess the value of the self-perpetuating black medic.

Project Coordinator:	John C. Gardner, **North Dakota State University Carrington Research Extension Center**
Major Participants:	**North Dakota State University Carrington:** B. Schatz, V. Anderson; **NDSU:** D. Watt; **Wisconsin Michael Fields Institute:** S. Guldan; **Kansas State University:** J. Havlin, A. Schlegel; **University of Nebraska:** R. Klein
Farmers:	North Dakota: D. Podoll, K. Ableidinger, C. Nelson, D. Dufner, T. Jacobson, D. Thomas, B. Neevel, E. Haakenson, D. Montgomery; **Minnesota:** C. Fernholz
Project Duration:	Started in 1988; now in fourth year.
Total Funding:	LISA Funds: $341,000; Matching Funds: $271,139

Evaluation of Integrated Low-Input Crop/Livestock Production Systems (LNC88-13)

Summary

Diversifying the biology and the economy of Northern Plains agriculture could be done by discovering new ways of integrating and re-introducing livestock into the agroecosystem. While the inclusion of ruminant animals in the production system may not be essential for the development of a more sustainable agriculture, several factors suggest that integrated crop-livestock production systems would be beneficial. Cereal grain straws are abundant in the Northern Plains farming areas. Legume hay crops are often included in low input cropping systems for nitrogen fixation and conservation. Legume hay, screenings and weather damaged grain crops complement crop residues in ruminant diets. Integrated enterprises not only maximize use and value of crop products as livestock feed, but also insure employment throughout the year. Economic viability, however, is necessary to continue operation regardless of production methods. Adding livestock to a crop farm will require additional management of manure and control of insects, particularly flies that feed on livestock and reproduce in manure. Increasing horn fly resistance to insecticides, EPA bans, and consumer concerns suggest a need for study of non-chemical approaches for fly control.

Project Coordinator: J. C. Gardner, **North Dakota State University Carrington Research Extension Center**

Major Participants: **North Dakota State University Carrington:** B. G. Schatz, V. L. Anderson; **NDSU Main Research Station:** S. Boyles, D. Watt, H. Meyer, D. Kopp; **NDSU Hettinger Research Center:** T. Faller; **University of Illinois:** R. A. Weinzieri; **University of Missouri:** R. D. Hall

Project Duration: 1 Year continuation funding

Total Funding: LISA Funds: $132,700; Matching Funds: $93,000 plus in-kind contributions

LISA Impacts: Social, Economic, and Demographic Impacts of Low-Input Sustainable Agriculture Practices on Farms and Rural Communities in the Northwest Area (LNC89-23)

Summary

The impacts of Low-Input Sustainable Agriculture (LISA) on farm economics, farm families, farming communities, regional centers, and state revenues is addressed in this research project. Paired comparisons were made between LISA and non-LISA farming operations in North Dakota. During summer 1989, questionnaires were designed and pretested. LISA farmers were paired with non-LISA farmers to provide research controls and to allow for comparisons of the two groups. A total of 35 operators involved in various NDSU Agricultural Experiment Station LISA production projects were surveyed. For each of these respondents, conventional operators in the same area, and with operations similar to the LISA farmers were surveyed. Thus, a total of 70 farmers participated in the study.

The survey consisted of a telephone questionnaire with a mail-out/mail-back follow-up. Items on the survey pertained to the respondents' farming practices, values and attitudes, farm finances, farm operation characteristics, community involvements, off-farm employment, and personal and family baackground. Based on the data collected from the two groups of farmers, models will be developed to determine the impact of LISA farming on local communities and on regional areas as it compares with non-LISA farming. Farmer involvement is critical for the design of the questionnaire, interpretation of the results, enhancing the acceptance of the findings by other farmers.

Following is a summary of the study's findings to date. No statistically significant differences were found between the two groups in the value of their farm assets or in the value of their farm liabilities. However, differences between the two groups were found in both their gross farm incomes and net farm incomes. Conventional farmers grossed an average of $104,057 in 1989 compared with $63,317 for LISA farmers. Conventional farmers netted an average of $2,153 in 1989 compared with $6,032 for LISA farmers.

One-third of LISA farmers and conventional farmers believed that the current farm programs kept them from planting a desired crop rotation. Whereas 18.2 percent of the LISA farmers and 29.4 percent of the conventional farmers believed current farm programs *damaged* their conservation efforts, the difference was not statistically significant. However, when asked if current farm programs *promoted* conservation efforts, 57.6 percent of the LISA farmers and 23.5 percent of the conventional farmers agreed that they did.

LISA operators were younger than were their conventional counterparts (42.7 years and 50.3 years, respectively). LISA operators' spouses were younger than were their conventional counterparts (means = 39.8 years and 45.9 years, respectively). The average household size of LISA operators was larger than that of conventional farmers (means = 4.4 members and 3.4 members, respectively). No differences were found in the number of years the farms were in their families.

A greater proportion of LISA operators engaged in off-farm employment (55.9 percent) compared to the conventional operators (17.6 percent). However, of the farmers who engaged in off-farm employment, no differences were found in the number of days the two groups worked off the farm. No differences were found between the two groups in the proportion of spouses who held off-farm employment, nor in the number of hours they worked off the farm.

No statistically significant differences were found in the number of acres owned by LISA and conventional farmers, nor in the number of acres they rented to others. Conventional farmers rented more acres from others (means = 1281.8 acres) than did LISA farmers (means = 510.3 acres). No differences were found between the two groups in the number of acres in the conservation reserve program (CRP), in pasture, hayland, or rangeland, or in woodland. Conventional farmers used conventional farming practices on a larger percentage of their cropland (means + 97.2 percent) than did LISA farmers (means = 63.1 percent). LISA farmers used organic practices on a larger percentage of their cropland (means = 29.2 percent) than did conventional farmers (means = 5.8 percent). No differences were found between the two groups in the use of no-till practices.

The farmers were asked how many acres of various types of crops they raised. Differences were found only in two types. LISA farmers raised more acres of buckwheat than did their conventional counterparts. No differences were found in the percent of feed or seed the two groups purchased that had been grown in their respective counties. LISA farmers sold a greater proportion of their crops through organic markets (means = 54.5 percent) than did the conventional farmers (means = 0.0 percent).

The farmers were asked how many years they used various farming practices. Conventional farmers had used conventional practices for an average of 23.8 years compared with 13.7 years for LISA farmers. No statistically significant differences were found in the number of years the two groups used no-till practices or organic practices. No statistically significant differences were found between the two groups in the number of acres they had in rotation with summer fallow, in the number of years they did soil sampling, or in the number of years they scouted for weeds and/or insects. No statistically significant differences were found in the percentage of cropland the two groups applied insecticide, fungicide, or herbicide. However, conventional farmers applied commercial fertilizer to an average of 63.1 percent of their cropland compared with LISA farmers who applied commercial fertilizer to an average of 37.9 percent of their cropland. LISA farmers used green manure for fertilizer on average of 5.6 percent of their cropland and conventional farmers used green manure for fertilizer on an average of only 0.9 percent of their cropland. No differences were found between the two groups' use of animal manure.

Project Coordinator:	David L. Watt, **North Dakota State University**
Major Participants:	**South Dakota State University:** L. Baer; **North Dakota State University:** G. A. Goreham
Farmer:	North Dakota: T. Jacobson
Project Duration:	2 Years
Total Funding:	LISA Funds: $65,300; Matching Funds: $65,300

Ruminant Production Systems Inter-Related With Non-Traditional Crop Management (LNC90-30)

Summary

This study is evaluating the practical, environmental and economical aspects of adding ruminant livestock to farms using traditional vs non-traditional crop management systems. Livestock trials are being conducted with lactating beef cows and ewes using high residue diets supplemented to make balanced rations. Limited or no pasture on many crop farms suggests an evaluation of drylot beef cow management. Two milk production levels will be studied with diets balanced to match productivity level using residues and cropping system products. One fourth of the calves from average milling cows will be weaned early, one cycle before the end of the 45 day breeding season. Early weaned calves will be offered diets with and without probiotic supplements. Calves weaned normally will be fed screenings vs barley based backgrounding diets with and without probiotic supplements.

The sheep production component will evaluate three diets 1) alfalfa; 2) alfalfa/wheat straw and 3) alfalfa/corn stover, in year round confinement. Manure collected will be quantified and analyzed for fertility value. Manure production will be quantified and analyzed in the cow and sheep components of the study. Cow manure will be composted and returned to the fields in the cropping system.

Low cost livestock housing constructed with crop biomass will be evaluated for practicality and durability.

During the two year study, two previously initiated 4-year cropping systems will be compared: conventional wheat-sunflower-barley-fallow system vs a low purchased input system of wheat with underseeded legume-legume-hay-corn-soybean. Three different tillage systems will be evaluated in field size plots: no till, minimum till and conventional till. Three fertility levels with commercial fertilizer will be applied (30, 30 and 90 lbs N per acre annually) plus composted cow manure at 6 tons per acre. Carbon and nitrogen flow from cropping system through the cattle and back to the land will be quantified. Soil micro-organism activity will be monitored. Production coefficients (grain and residue yields) from the cropping systems will be used in a model to compare the whole farm returns form conventional cropping systems, low input cropping systems and low input cropping systems with beef or sheep livestock enterprises supplemented with bean splits. Bean splits are cull beans and screenings, a by-product of the edible bean industry from navy, pinto, and kidney beans.

March and April born calves will be offered creep feed starting in June. Barley malt pellets, a by-product of the brewing industry obtained from an area malt plant will be creep fed equally to calves in all pens. This product is guaranteed at 14% protein, 15% fiber, 1.3% fat and estimated at 70 to 75% TDN. Its cost has routinely been less than barley grain. *In vitro* fermentation will be used to measure digestibility of stover, straw, screenings, and by-product feeds and complete rations for cows, feeder cattle and sheep.

Cows will be weighed and condition scored (9 point system) after calving, at the end of the 50 day breeding season and at weaning in mid-September. Cows will be wintered together on diets balanced with straw, alfalfa-grass hay and limited amounts of corn silage. Birth weights, birth dates, actual and 205 day adjusted weaning weights will be reported. Conception rates will be determined by fall palpation.

Farmer cooperators will compare performance of moderate milking beef cows fed high residue diets supplemented with legume hay and screenings vs. similar cows grazing native pastures. Condition scores, weights and conception rates will be monitored on all cows. Feed consumption of drylot cows and creep feed for calves will be monitored.

Feeder Cattle Earlly weaned calves of both sexes will be allotted to one or two diet treatments. A control ration of approximately equal parts corn, barley, and chopped alfalfa-grass hay will be compared to the same diet with a probiotic supplement. Probiotics are naturally occurring microorganisms that commonly populate the rumen. Regular feeding prior to and during stress periods essentially seeds the rumen with millions of microflora possibly reducing the need for antibiotics. In addition to reducing effects of stress, probiotic supplements may enhance feedlot acclimation, increase feed consumption and performance of the calves.

Steer calves weaned in mid-September will be fed a preconditioning ration for 30 days evaluating diets containing screenings and probiotics. Gains, feed efficiency and in vitro digestibility of the diets will be monitored.

Sheep The NDSU-Hettinger Research Extension Center will conduct sheep trials using Rambouillet ewes allotted to three different self fed diets: 1) high input (HI) ground alfalfa diet; 2) low input 50% alfalfa -- 50% wheat straw dies (LIW); and 3) low input 50% alfalfa -- 50% corn stover (LIC) diet. Each diet will be replicated twice each year. Animals will be maintained inside a controlled environment facility. Alfalfa will be fed as haylage. In vitro fermentation will be used to measure digestibility of ration components. Typical performance information (weight gain, feed consumption, conception rate, percentage of twins and health problems) will be collected over the two consecutive 365 day treatment periods. Manure will be collected, quantified, analyzed for fertility, and applied raw to fields.

A sheep development project initiated by the State of North Dakota Governor's Office will provide cooperators for commercial low input sheep production. These producers are new to the sheep industry and are being trained and assisted by the coordinator(s) of the North Dakota Sheep Development Project. This group will assist in evaluating the

practicality of adding a low input sheep enterprise to existing grain farms. Sheep producers in the Northern Plains need some shelter for their flocks. This shelter need not be sophisticated or expansive. New sheep producers with minimum resources to invest are seeking alternatives to conventional steel or wood barns. In some low input sheep flocks housing will be constructed using baled crop biomass, minimum lumber and inexpensive roofing. These "structures" will be evaluated for relative cost, durability and usefulness in protection from the elements.

Cropping System The cropping system at the NDSU-Carrington Research Extension Center used in this study consists of both common and alternative rotations to the cereal grain producing regions of the Northern Plains states. A conventional system (wheat-sunflower-barley-fallow) and alternating legume (wheat with underseeded legume-legume hay-corn-soybean) rotations will be examined over a range of tillage practices and nitrogen applications from commercial fertilizers and composted livestock manure. The cropping systems experiment has been ongoing since 1987 and is a long-term study, occupying 50 acres of land. Plots are large and regular field equipment is used.

The three treatments are 1) no-tillage, where herbicides are used exclusively for weed control and no tillage is performed, 2) minimum tillage, where all tillage is performed shallowly with sweeps and a rotary how and herbicides are used only when necessary, and 3) conventional tillage, where inversion tillage with an offset disk followed by secondary tillage results in little residue remaining after planting.

Fertility treatments include annual surface applications of ammonia nitrate to the non-fallow, non-legume crops at rates of 30, 60, and 90 lbs. of actual N per acre. A fourth treatment of composted beef cow manure from the drylot cow herd at a rate of approximately 6 tons of dry matter per acre was also added in 1989.

Carbon and nitrogen flow from the cropping system, to the ruminant and back to the cropping system will be quantified. The effect of both composted and fresh livestock manure, as well as green legume manure will be compared as crop nitrogen sources and for their influence on soil biological activity and crop and weed yields. The form and release of carbon and nitrogen will be examined to better understand the dynamics of nutrient flow under the integrated system as compared to unmanured conventional crop rotations.

Economic analysis The focus of economic analysis will be on maximizing "net farm income." Data generated from the cropping system study and livestock trials will be entering into a "Low-Purchased-Input Farming Systems" (LPIF) model for linear programming analysis. Comparisons will include (10 traditional farming practices for crops only enterprises, 2) LPIF for crops only enterprises and 3) LPIF for crops-livestock (beef cows or sheep). Coefficients of production (grain yield, residue harvested) developed from the cropping system study will be used to determine economic potential and to model the ruminant carrying capacity. Numbers of animals will be limited by labor, feed supply or other variable considered in the formula.

Project Coordinator:	Vernon L. Anderson, **NDSU Carrington Research Center**
Major Participants:	**NDSU Carrington Research Center:** J. C. Gardner, B. G. Schatz; **NDSU Main Research Station:** S. Boyles, D. Kopp, H. J. Meyer, J. E. Struble, D. L. Watt; **NDSU Hettinger Research Center:** T. Faller; **University of Missouri:** R. D. Hall; **Universtiy of Illinois:** R. R. Weinzierl
Project Duration:	2 Years (Funding from September 1, 1990 to September 1, 1992)
Total Funding:	LISA Funds: $108,800; Matching Funds: $108,700

Agronomic and Economic Analyses of Alternative Small Grain/Row Crop Production Systems for the Northern Plains (LNC88-9)

Summary

This project is a continuation of a long-term investigation of alternative, low-input agriculture initiated in 1984 by South Dakota State University. The overall objective of this multi-disciplinary effort is to compare the agronomic and economic sustainability of alternative, conventional, and reduced-tillage farming systems. The alternative systems use primarily on-farm resources to meet crop nutrient needs and to control pests. One complete cycle of all crop rotations in the replicated experimental systems was completed in 1988. Investigations include agronomic and whole farm economic analyses of the experimental farming systems and also of producers' systems.

Objectives

1. Measure inputs, yields, soil physical and biological properties, earthworms, mycorrhizal associations, and pests. Farming systems are being modeled to determine whole farm impacts in regard to labor and managerial requirements, farm production costs, profits, solvency, and liquidity.

2. Estimate the effects of different livestock enterprises, Federal Farm program provisions, crop yields and prices, and agrichemical prices are included in the models.

3. Analyze transition effects and of comparisons of alternative and conventional farms will be completed.

4. Continue networking with Minnesota, Montana, Nebraska, and South Dakota, and the Northern Plains Sustainable Agriculturral Society.

5. Continue extending information through field tours, progress reports, producer/research workshops, media news releases, newsletters and journals.

Project Coordinator:	James D. Smolik, **South Dakota State University,** Plant Science Department, Box 2109, Brookings, SD 57007
Major Participants:	**South Dakota State University:** George Buchenau, Thomas Dobbs, Diane Rickeri, Donald Taylor, and Leon Wrage
Cooperators:	University of Minnesota: Kent R. Crookston; **North Dakota State University:** John C. Gardener; **South Dakota State University:** Robert G. Hall, David D. Walgenbach; **University of Nebraska:** Warren W. Sahs; **Montana State University:** James R. Sims
Conventional Farmer:	**South Dakota:** Kris Johnke
Low-input Farmers:	**South Dakota:** Allan Johnson; Charles Johnson; **North Dakota:** Fred Kirschenmann, President of Northern Plains Sustainable Agricultural Society, Windsor, ND
Project Duration:	Started 1988, now in fourth year.
Additional Funding:	September 1, 1992
Total Funding:	LISA Funds: $194,650; Matching Funds: $159,250